

WHAT IS CLAIMED IS:

1. A semiconductor device comprising:

a semiconductor substrate having a p-well and an n-well at a surface portion thereof;

5 an insulation film formed on the semiconductor substrate and having an opening, at a bottom of which the p-well or n-well is exposed;

a gate insulation film formed on the n-well or p-well exposed at the bottom of the opening;

10 a first gate electrode including a first metal-containing film, which is formed in contact with the gate insulation film on the p-well and has a Fermi level on a conductive band side from a substantial center of a band gap of the semiconductor substrate, and a second metal-containing film formed on the first metal-containing film and having a lower resistance than the first metal-containing film;

15 a n-type source and a n-type drain formed on the semiconductor substrate and configured to sandwich the first gate electrode;

20 a second gate electrode including a conductive coating film, which is formed in contact with the gate insulation film on the n-well and has a Fermi level on a valence band side from a substantial center of the band gap of the semiconductor substrate, the conductive coating film being formed only at a bottom of the opening, and the second metal-containing film formed on

the conductive coating film and having a lower resistance than the conductive coating film; and

an p-type source and an p-type drain formed on the semiconductor substrate and configured to sandwich the second gate electrode.

2. A semiconductor device according to claim 1, wherein said first metal-containing film is one of a hafnium nitride film, a zirconium nitride film and a titanium nitride film.

3. A semiconductor device according to claim 1, wherein said conductive coating film contains carbon.

4. A method of fabricating a semiconductor device comprising:

forming a structure comprising a p-well and an n-well formed on a surface of a semiconductor substrate, an n-type source and an n-type drain formed on the surface of the semiconductor substrate and configured to sandwich a channel region of a n-type MIS transistor formed at the p-well, an insulation film having openings, at bottom of which the p-well and the n-well are exposed, the n-type source and n-type drain formed on the p-well and configured to sandwich the associated opening, and a p-type source and a p-type drain formed on the n-well and configured to sandwich the associated opening;

forming a gate insulation film on the p-well and the n-well exposed at the bottoms of the openings;

forming a first metal-containing film on the p-well and the n-well exposed at the bottoms of the openings, the first metal-containing film having a Fermi level on a conductive band side from
5 a substantial center of a band gap of the semiconductor substrate;

removing the first metal-containing film on the n-well;

forming a conductive coating film on the first
10 metal-containing film and on the gate insulation film formed on the n-well, the conductive coating film having a Fermi level on a valence band side from a substantial center of the band gap of the semiconductor substrate; and

15 forming a second metal-containing film on the conductive coating film, the second metal-containing film having a lower resistance than the first metal-containing film and the conductive coating film, thus filling the openings.

20 5. A method according to claim 4, wherein the formation of the conductive coating film including:

a step of forming an insulative coating film with a substantially flat surface on the first metal-containing film on the p-well and on the gate
25 insulation film on the n-well, thus filling the openings;

a step of selectively etching the coating film and

exposing the openings once again while leaving the coating film; and

5 a step of subjecting the coating film to a predetermined process, thereby making the coating film electrically conductive.

6. A method according to claim 5, wherein said coating film is formed of an organic material containing carbon, and

10 said predetermined process subjects the coating film to heat treatment, laser anneal or electron radiation.

15 7. A method according to claim 5, wherein said coating film is formed of an organic material having benzene rings serially connected, and iodine is introduced in the coating film in said predetermined process.

8. A method according to claim 4, wherein the formation of the conductive coating film including:

20 a step of forming a conductive coating film with a substantially flat surface on the first metal-containing film on the p-well and on the gate insulation film on the n-well, thus filling the openings;

25 a step of selectively etching the coating film and exposing the openings once again while leaving the conductive coating film.